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Original Research

Infectious agents and antibiotic resistance in the burn unit

Infections of the burn unit

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Abstract
Aim: In terms of hospital infections, patients in the burn unit have a special importance. In these patients, the physical, cellular and humoral defense systems are impaired, and the potential of microorganisms to cause infection increases. In our study, it was aimed to determine the types of microorganisms isolated from all cultures taken from patients hospitalized in the burn unit of our hospital, the types of infections they cause, and antibiotic resistance and antibiotic resistance rates.
Material and Methods: In our study, microorganisms and antibiotic resistance profiles isolated from patients hospitalized in the Burn Unit of Dr. Lutfi Kirdar Kartal Training and Research Hospital between January 1 and December 31, 2009 were evaluated retrospectively.
Results: During this period, 458 patients hospitalized in the burn unit were followed up and 327 microorganisms were isolated from 116 (25.3%) patients. Of these microorganisms, 72.2% were Gram-negative bacteria, 20.2% were Gram-positive bacteria, and 7.6% were fungi. The most frequently isolated microorganisms were Pseudomonas aeruginosa (31.2%) and Acinetobacter baumannii (29.4%), followed by Staphylococcus aureus (9.2%) and Candida spp. (7.0%). The antibiotics to which Pseudomonas aeruginosa was most sensitive were amikacin, ciprofloxacin, gentamicin, meropenem and imipenem, respectively, while the most antibiotic resistance was found to cefoperazone-sulbactam and piperacillin-tazobactam. Acinetobacter baumannii was most sensitive are colistin and tigecycline; while no resistance to colistin was detected, resistance to tigecycline was found to be 14.3%. There was more than 90% resistance to other antibiotics. Methicillin resistance was found in 83.3% of the isolated Staphylococcus aureus strains, and no resistance was found to vancomycin, teicoplanin and linezolid in any of the Gram-positive bacteria.
Discussion: Gram-negative bacteria, mainly Pseudomonas aeruginosa and Acinetobacter baumannii, constitute the dominant flora in the burn unit, and in these microorganisms, high resistance to antibiotics was noted. For the empirical antibiotic approach, each unit should follow its own infection surveillance and antibiotic resistance rates, and in order to prevent infections, infection control measures should be followed and the appearance of infection should be prevented.

Keywords
Burn Unit, Antibiotic Resistance, Infectious Agents

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Introduction

The burn is caused by contact with the skin of hot, cold or chemicals, most often it occurs as a result of thermal damage caused by hot water or flame. The depth of the resulting burn depends on the intensity of the heat, the contact time and the thickness of the skin [1]. If the burn is limited by the epidermis, it is defined as a first-degree burn; second-degree burns affect both the epidermis and the dermis; third-degree burns affect muscles and the bone under the dermis; if all layers of the skin are affected, this is defined as carbonization [2].

The type of burn, the depth and width of the burn area are determining factors for the number of colonizing microorganisms [2,3]. In the early period (within the first 48 hours), the burn area is colonized by staphylococci present in the sweat glands, hair follicles or intact skin flora outside the burn area, colonization of Gram-negative bacteria occurs after 48 hours and fungi after about a month [2,4,5]. Gram-negative bacteria play an important role in colonization and invasion because they are motile, develop resistance to antibiotics, and secrete enzymes such as elastase, collagenase, lipase, and protease [2,6].

Infections are important causes of morbidity and mortality in burn patients. The treatment of burn patients requires multidisciplinary approaches such as early debridement of necrotic tissue, closure of the wound, adequate nutrition, providing fluid-electrolyte support, as well as appropriate antibiotic treatment and infection control measures.

The agent distribution and antibiotic sensitivity in each unit are different. For this reason, in the burn unit, where the risk of infection is very high, it is important to know the most common pathogens and their sensitivity to antibiotics, to take infection control measures for these agents and direct empirical treatments.

In our study, it was aimed to determine the types of microorganisms isolated from all cultures taken from patients hospitalized in the burn unit of our hospital, the types of infections they cause, and antibiotic resistance and antibiotic resistance rates.

Material and Methods

In our study, microorganisms and antibiotic resistance profiles isolated from patients hospitalized in the Burn Unit of Dr. Lutfi Kirdar Kartal Training and Research Hospital between January 1 and December 31, 2009 were evaluated retrospectively. During this period, 458 patients hospitalized in the burn unit were followed up and 327 microorganisms were isolated from 116 (25.3%) patients.

Deep tissue culture and blood culture (Bact/Alert 3D) were taken from patients with suspected burn wound infection. Microorganisms growing in both cultures were identified. Classical microbiological methods were used for this purpose. Additionally, API 20E (BIOMERIEUX) and API 20N (BIOMERIEUX) systems were used to identify Gram-negative bacteria.

The evaluation was carried out according to NCCLS (National Committee of Clinical Laboratory Standards) / CLSI (Clinical Laboratory Standards Institute) criteria.

Results

Out of 458 patients followed in the burn unit of our hospital between January 1 and December 31, 2009, 31.9% (n=146) were females, 68.1% (n=312) were males, and the female/male ratio was approximately ½. Infection developed in 116 of 458 patients. Of these 116 patients, 30 (25.9%) were female and 86 (74.1%) were male, with an age range of 1-66 and a median age of 29.2 years. Burns due to flame and hot water were observed most frequently in these patients.

The percentages of burns in which infection developed the most were 20-29%, 40-49% and 10-19%, respectively.

Of 116 patients, 29.3% (n=34) were classified as second-degree burns and the remaining 70.7% (n=82) as third-degree burns. Partial charring occurred in three patients with third-degree burns.

A total of 327 microorganisms were isolated from 116 patients included in the study, of which 217 (66.4%) were in deep tissue culture taken from the burn area, 52 (15.9%) in blood culture, 32 (9.8 %) in urine culture, 16 (4.9%) catheter tip culture, 9 (2.9%)

Table 1. Microorganism Growth Distribution.

Microorganism	n	%
Gram-negative bacteria	236	72,2
Pseudomonas aeruginosa	102	31,2
Acinetobacter baumannii	96	29,4
Escherichia coli	16	4,9
Proteus spp.	7	2,2
Citrobacter spp.	6	1,8
Klebsiella spp.	5	1,5
Enterobacter spp.	4	1,2
Gram-positive bacteria	66	20,2
Staphylococcus aureus	30	9,2
Diphtheroids spp.	19	5,8
Coagulase-negative staphylococci	15	4,6
Enterococcus spp.	2	0,6
Fungi	25	7,6
Candida spp.	23	7
Aspergillus spp.	2	0,6
Total	327	100

Table 2. Distribution by agents and materials.

Microorganism	Wound	Blood	Urine	Catheter	Other	N	%
P.aeruginosa	80	9	6	3	4	102	31,2
A.baumannii	54	19	12	5	6	96	29,4
S.aureus	24	3		3		30	9,2
Candida spp.	1	10	8	4		23	7
Diphtheroids spp.	16	2		1		19	5,8
E.coli	12		4			16	4,9
CNS	9	6				15	4,6
Proteus spp.	7					7	2,2
Citrobacter spp.	5	1				6	1,8
Klebsiella spp.	4	1				5	1,5
Enterobacter spp.	3	1				4	1,2
Enterococcus spp.	2					2	0,6
Aspergillus spp.	2					2	0,6
Total	219	52	30	16	10	327	100

(CNS: Coagulase-negative Staphylococcus, Other: tracheal aspirate, eye swab)

Table 3. Antibiotic resistance percentages of gram-negative bacteria.

	P.aeruginosa (n=102)	A.baumannii (n=96)	E.coli (n=16)	Proteus spp. (n=7)	Citrobacter spp. (n=6)	Klebsiella spp. (n=5)	Enterobacter spp. (n=4)
Ceftriaxone	100	100	54	0	25	100	50
Cefotaxime	100	100	54	0	25	100	50
Gentamicin	30,6	87,4	25	0	25	100	100
Amikacin	13,7	88,3	20	0	25	50	100
Cotrimoxazole	-	92,3	80	80	0	50	0
Ciprofloxacin	24,2	98,9	50	75	25	100	0
Imipenem	30,9	92,5	0	0	25	100	0
Ceftazidime	39,8	98,9	50	0	25	100	50
Cefoperazone Sulbactam	53,8	97,8	54,5	0	25	100	100
Meropenem	28,2	92,6	0	0	25	100	0
Cefepim	37,9	97,7	44,4	0	25	100	100
Piperacillin Tazobactam	44,7	98,8	50	0	25	100	50
Tigecycline	-	14,3	0	-	0	0	0

deep tracheal aspirate culture, 1 (0.3%) eye swab culture.

Of the 327 isolated microorganisms, 236 (72.2) were Gram-negative bacteria, 66 (20.2%) were Gram-positive bacteria and 25 (7.6%) were fungi (Table-1).

The first three were P.aeruginosa, A.baumannii and S.aureus. These three were the causative agents in 69.8% of all burn infections. P.aeruginosa and A.baumannii constituted 83.9% of Gram-negative bacteria, and the remaining 16.1% were other Enterobacteriaceae family members such as E.coli, Klebsiella spp., Proteus spp., Citrobacter spp. and Enterobacter spp. When the distribution of the agents according to the materials was examined, in deep tissue culture, P.aeruginosa, A.baumannii and S.aureus took the first three places, while in blood and urine cultures, the first three places were taken by A.baumannii, Candida spp. and P.aeruginosa (Table 2).

When studying the sensitivity of the most frequently distinguished microorganism P.aeruginosa to antibiotics, it was found that P.aeruginosa is most sensitive to amikacin (86.3%) ciprofloxacin (75.8%), meropenem (71.8%), gentamicin (69.4%) and imipenem (69.1%), respectively. The antibiotics to which it was most resistant were cefoperazone-sulbactam (53.8%) and piperacillin-tazobactam (44.7%) (Table 3).

The antibiotic to which A.baumannii is most sensitive is tigecycline with 85.7%. The rate of resistance to tigecycline was 14.3%. Colistin susceptibility of 19 A.baumannii isolates isolated from blood was measured with the E test and all were found susceptible (Table 3).

Apart from these two Gram-negative microorganisms, Enterobacteriaceae family members E.coli, Proteus spp., Citrobacter spp., Klebsiella spp. and Enterobacter spp. were isolated.

Although the number of isolates is not high, it is noteworthy that antimicrobial resistance patterns were high. While the antibiotics to which they were most sensitive were imipenem, meropenem, amikacin and gentamicin, an average of 50% resistance was found to other antibiotics. Extended-spectrum beta-lactamase (ESBL) production rate was determined as 29% in these isolates.

Among Gram-positive bacteria, S.aureus, Diphtheroids spp. and Coagulase-negative Staphylococci are the most common cause of burn infections. 83.3 % methicillin resistance in S.aureus strains and 86.7 % resistance in Coagulase-negative Staphylococci were detected. While all staphylococci were resistant to penicillin, no Gram -positive bacteria were resistant to vancomycin, teicoplanin and linezolid.

Discussion

In our study, the most common infections in our burn unit were burn wound infections at 66.4%, bloodstream infections at 15.9% and urinary tract infections at 4.9%. Similar to our study, Ekrami et al. reported the most common infections in 182 burn patients in a one-year period such as burn wound infections in 72.5%, bloodstream infections in 18.6%, and urinary tract infections in 8.9% [7].

72.2% were Gram-negative bacteria, 20.2% were Gram-positive bacteria and 7.6% were fungi. According to the agent distribution, P.aeruginosa with 31.2% (n=102), A.baumannii with 29.4% (n=96) and S.aureus with 9.2% (n=30) were in the top three. In the nine-year study by Al-Akayleh AT, the distribution was as follows: Pseudomonas spp. 50.7%, Klebsiella spp. 42.6%, S.aureus 36.4%, Proteus spp. 29.9%, E.coli 21.5%, Candida spp. Reported as 11.3% [8].

In our study, P.aeruginosa was the most common causative agent, whereas in other studies it accounted for 18%-59%, in our study, it was isolated at a rate of 31.2%. An important problem in the burn unit is antibiotic resistance. The least resistance was to amikacin (13.7%). Resistance to ciprofloxacin was 28.2%, to meropenem 30.6%, to gentamicin 30.9%, to cefepime 37.9%, to ceftazidime 39.8%, to piperacillin-tazobactam 44.7%, and to cefaperazone-sulbactam 53.8%.

The second most common agent was A.baunannii. While all strains were sensitive to colistin, there was 14.3% resistance to tigecycline. This rate was found to be high compared to other studies. Ludvik et al. found high sensitivity to colistin in their study in 2009 (9).

The third agent was S.aureus (n=30) at 9.2%, and MRSA-resistance was 83.3% (10). Reig A et al. found the average hospital stay of infected patients to be 30 days (11).

Candida spp. (7%) and Aspergillus spp. (0.6%) were isolated as fungal agents in 25 (7.6%) of the 327 isolates included in the study. Lorente L et al. detected Candida spp., Aspergillus spp. and Fusarium spp. in burn infections [12].

Conclusion

Each burn unit should carry out its own infection surveillance and determine the infecting microorganisms and antibiotic resistance pattern. Infection control strategy should be made more effective in burn units, staff training and hand hygiene should be emphasized.

Scientific Responsibility Statement
The authors declare that they are responsible for the article's scientific content including study design, data collection, analysis and interpretation, writing, some of the main line, or all of the preparation and scientific review of the contents and approval of the final version of the article.

Animal and human rights statement
All procedures performed in this study were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards. No animal or human studies were carried out by the authors for this article.

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Conflict of interest
The authors declare no conflict of interest.

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